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THE BOTANICAL GAZETTE

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In the July number will appear:

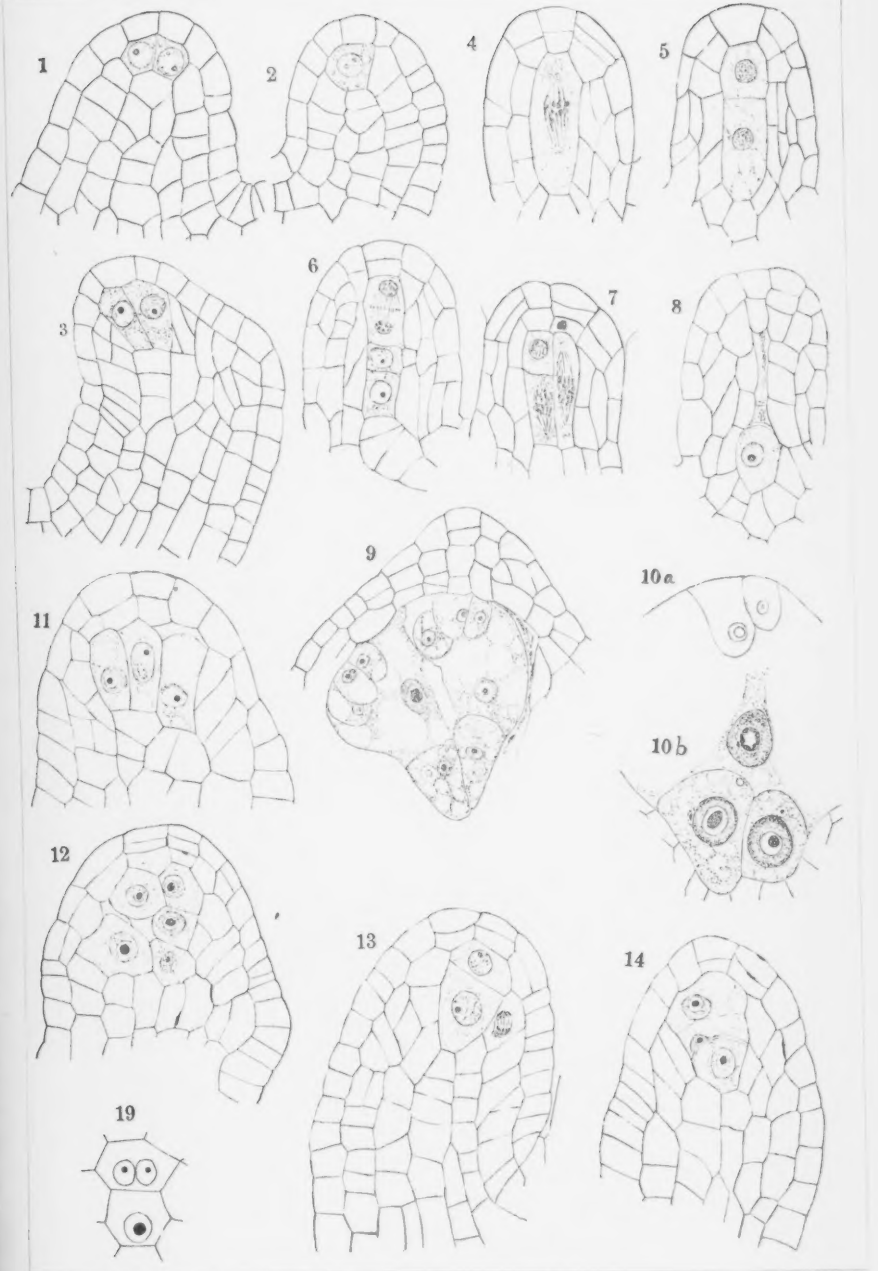
Synopsis of North American Amaranthaceæ. IV, by EDWIN B. ULINE and WM. L. BRAY, *Lake Forest University.*

Some observations on the development of Colletotrichum lindemuthianum in artificial cultures, by PROF. GEO. F. ATKINSON, *Cornell University.*

On the validity of some fossil species of Liriodendron, by THEO. HOLM, *U. S. Dept. of Agriculture, Washington.*

Contributions to the embryology of the Ranunculaceæ *will be concluded.*

The articles on the nomenclature question, by Drs. Ganong and E. F. Smith, have been delayed, but the editors hope that they will appear in the July number.



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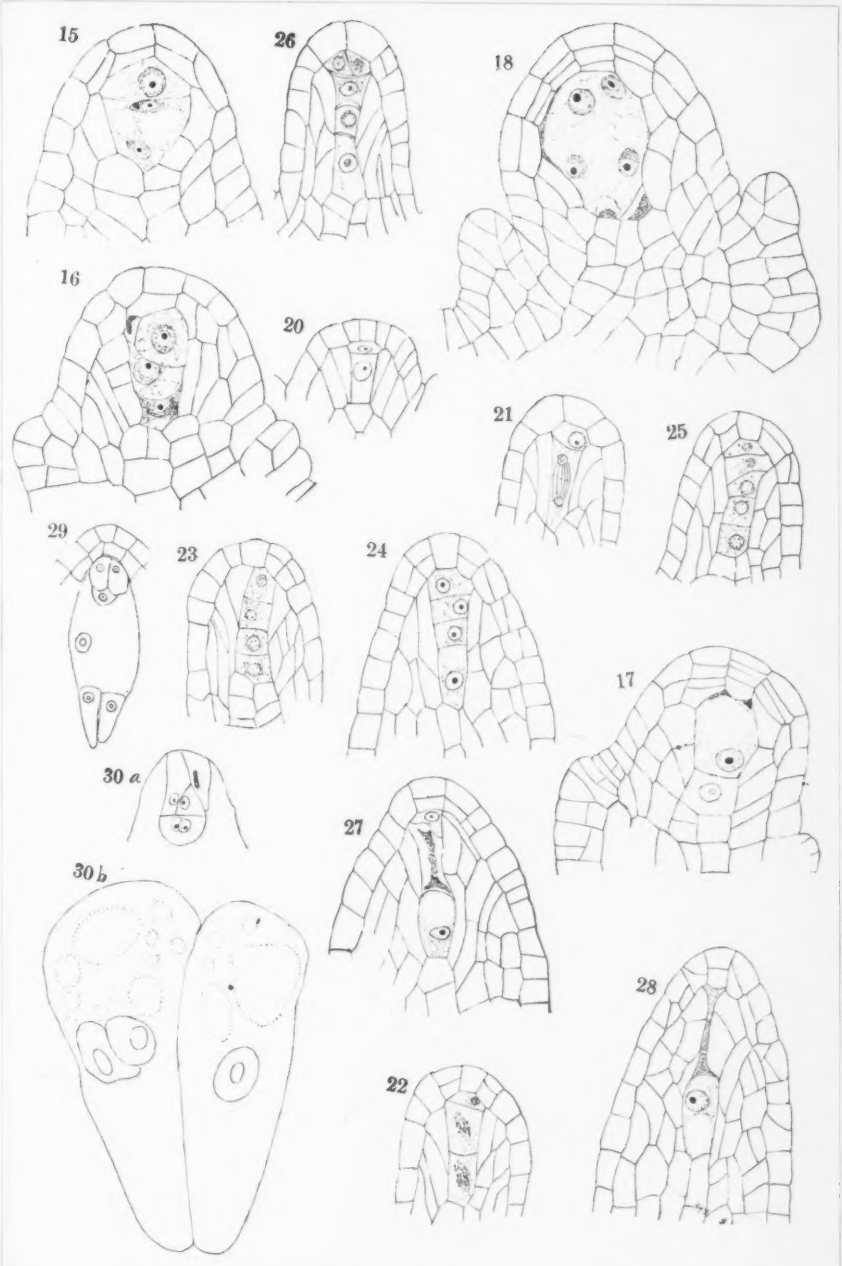

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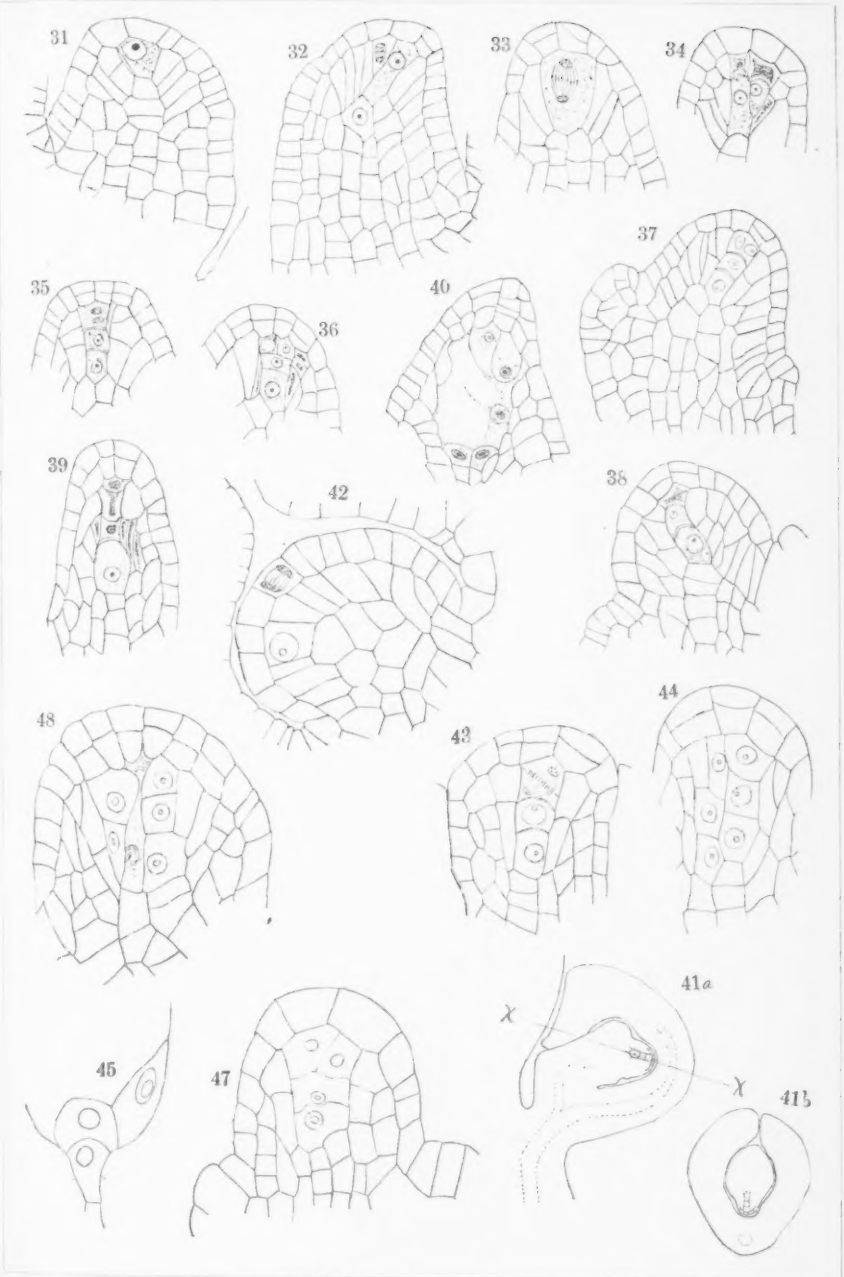

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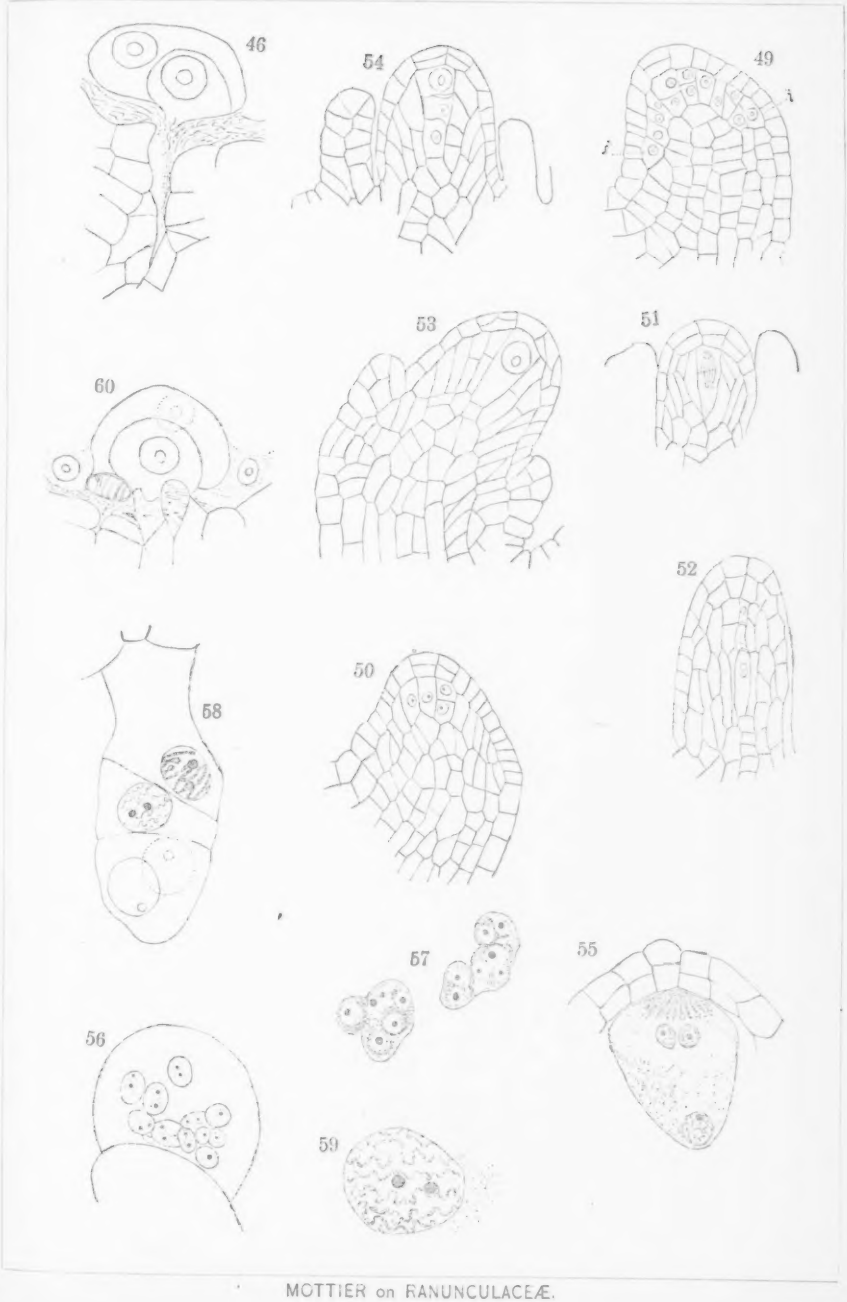

MOTTIER on RANUNCULACEÆ.

BOTANICAL GAZETTE

JUNE, 1895.

Contributions to the embryology of the Ranunculaceæ.[1]

WITH PLATES XVII–XX.

DAVID M. MOTTIER.

Various representatives of the Ranunculaceæ have been subjected to much careful study from the standpoints of morphology, histology and embryology. The well known resemblance to the monocotyledons in the structure of the vascular bundle, secondary growth of the stem and the large size of their meristematic cells, has brought to several species of this family much of that careful investigation that is usually centered upon transitional characteristics. Of all the dicotyledons certain species of the Ranunculaceæ resemble more closely the monocotyledons in the large size of their embryonic cells.[2] For this reason certain species are especially favorable for embryological studies. From a desire to know more about the development of the embryo-sac, a study of one or more species of several available genera was begun.

Prantl[3] arranges the genera of this family under three subdivisions, Paeonieæ, Helleboreæ and Anemoneæ. Of the Paeonieæ no representative was available for study; of the Helleboreæ the following species were investigated: *Delphinium tricorne* Michx., *Caltha palustris* L., *Aquilegia Canadensis* L.; of the Anemoneæ, *Ranunculus abortivus* L., *R. recurvatus* Poir., *R. septentrionalis* Poir., *Anemonella thalictroides* Spach, *Thalictrum dioicum* L. and *Hepatica acutiloba* DC.

The subject naturally embraces three phases, namely; the development of the embryo-sac, the process of fertilization, and the development of the embryo.

The following pages will be confined almost exclusively to

[1]Contributions from the Botanical Laboratory of the University of Indiana.
[2]Strasburger, Histologische Beiträge 5: 118. 1893.
[3]Natürlichen Pflanzenfamilien.

the development of the embryo-sac and its behavior previous to fertilization. The different species will be taken up in the order indicated above.

Delphinium tricorne.—As is well known the ovules of Delphinium arise as nipple-like protuberances from the infolded margins of the carpophyll. The epidermal and hypodermal rows of cells of the carpophyll pass uninterruptedly over this rudiment of the ovule. At the apex of the protuberance may be seen one or frequently more hypodermal cells distinguishable by their larger size (fig. 2). The cell which ultimately gives rise to an embryo-sac will, for greater clearness, be spoken of in this paper as the initial cell of the embryo-sac, while the term mother-cell will be reserved for the lower one of the longitudinal row of cells arising from subsequent divisions of this cell. In the very young rudiment of the ovule (fig. 1) in a large number of cases the initial cell of the embryo-sac is not perceptibly different from the other hypodermal cells nor the cells of the young ovule in general. It is usually stated that the initial cell of the embryo-sac is the terminal one of an axial row of cells of the nucellus, especially in monocotyledons which possess small ovules. In larger, small-celled ovules, those of the dicotyledons particularly, proof of an axial row is indeed difficult, if not quite impossible. In few cases in Delphinium an axial row could be determined (fig. 2); but it is very evident, even in the most favorable cases, that the initial cell or cells sustain a closer genetic relationship with the hypodermal layer than with any other cells of the nucellus (figs. 1–3).

The initial cell now increases in size, and divides by a transverse wall into two cells, the lower being frequently a little larger than the upper (figs. 4, 5, 7). When the first division is completed in the initial cell, the epidermal cells of the nucellus have divided by periclinal walls, and the inner integument has attained a level with the apex of the nucellus. Each of the two resulting cells (fig. 5) now divide by a wall parallel to the first, thus giving rise to four cells by two successive divisions of the initial cell of the embryo-sac. These transverse walls are very thin membranes without being the least swollen in the instances figured. As far as observation extended, the division of the lower cell preceded that of the upper, as will be seen in figs. 6 and 7. These divisions follow as a rule in rapid succession. The lower one of the

row of four cells now becomes a mother-cell of the embryo-sac. It increases in size, gradually absorbing the three cells above and also the adjacent cells of the nucellus, a process that almost invariably obtains in all angiosperms. In fig. 8 the mother-cell may b seen separated from the disorganized remains of the three superposed cells by an arched wall which is somewhat swollen.

The nucellus here has elongated, so that at this stage of development the three disorganized cells do not appear as flattened caps above the encroaching mother-cell, but seem to form only a narrow cavity containing a structureless substance which stains deeply. I have not been able to show this accurately in the pen drawing. This cavity is made narrow both by the increase in length of the nucellus and by the turgor of the cells immediately surrounding it. The walls of the turgid cells here in question, which border upon the cavity, are usually much swollen. The mother-cell now develops into the embryo-sac in the normal manner. The mature embryo-sac is covered by the nucellar cap varying from two to four cells in thickness. The antipodal cells attain an extraordinary size compared with that of the egg-apparatus, as a glance at figs. 10*a* and 10*b* will plainly show. This condition of affairs exists in the embryo-sac at the time of anthesis or shortly before. The three cells almost always lie side by side in the same horizontal plane, consequently only two are shown in the figure, the other being in the next successive section. They gradually increase in volume with the subsequent growth of the embryo-sac, and persist for a time after fertilization, when they are finally absorbed. About the time of fertilization they may be seen upon a projection of the chalaza at that end of the sac which has now become very broad. However, the position of the antipodal cells varies considerably in different ovules. Strasburger has called attention to the enormous size of the antipodal cells in *Delphinium villosum.*[4] In Delphinium tricorne the writer did not find the difference to be quite so great. We shall return to this phenomenon further on.

The only account of the development of the embryo-sac in any representative of the Ranunculaceæ to which I have access is that given by Strasburger[5] for *Myosurus minimus.* In

[4]Strasburger, Ueber Befruchtung und Zelltheilung 38. 1878.
[5]Strasburger, Die Angiospermen und Gymnospermen 13. 1879.

this plant the author finds that the initial cell gives rise to a row of only three cells, the lower one of the series developing into the embryo-sac in the normal way. It will be seen that Delphinium differs from Myosurus in that four cells result from two successive cell divisions of the initial cell, of which the lower one gives rise directly to the embryo-sac. It is not improbable, however, that occasionally only three cells are formed here as in Myosurus, a phenomenon that was observed in other genera to be mentioned later.

The most remarkable phenomenon met with here is the presence of two and sometimes more initial cells and their development into mature embryo-sacs. In figs. 1 and 3 may be seen two initial cells of about equal size. In a number of cases one of the cells was somewhat larger than the other. The larger would in all probability take the upper hand of the smaller, thus crowding it out when only one embryo-sac would be the result. Frequently two cells were observed in later stages of development (fig. 7), both of which would, without doubt, produce mature embryo-sacs. As a rule one cell is a little in advance of its neighbor in development (fig. 7, the cell on the left). This state of things is not exceptional, but in some carpels a large number of ovules presented two, and occasionally three, initial cells. It is certain that every initial cell does not ultimately result in a mature embryo-sac, for it seems that there is unquestionably a "struggle of the parts" here as elsewhere. No more than two embryo-sacs were observed in one ovule. In fig. 9 are shown two fully developed embryo-sacs, apparently of equal size and importance. The antipodal cells lie side by side in a plane at right angles to the plane of the section. By focusing deeper other nuclei could be seen, and in an adjacent section the other antipodal cells were visible. The two embryo-sacs were contiguous for their whole length, separated only by a very thin and indistinct membrane. For lack of time a very large number of ovules was not examined to ascertain the frequency of the phenomenon, nor is it known to the writer whether more than one embryo-sac is fertilized, and in that event whether more than one embryo ever reaches maturity in a single seed of Delphinium.

We do not have to do here with an isolated phenomenon, for the presence of more than one embryo-sac in one ovule has been observed several years ago by Hofmeister,[6] Tulasne, Schacht and others.

[6] Strasburger, Ueber Befruchtung und Zelltheilung 36 and foot note.

Tulasne claims to have observed five or six embryo-sacs in a single ovule; but it is probable that the methods used in the preparation of objects by earlier observers were less accurate than those employed by more recent investigators, consequently such statements may be reasonably questioned. The most remarkable instance, however, is that noted by Strasburger[7] for *Rosa livida.* I quote from this author as follows: "Im fertigen Zustande sah ich die Embryosäcke stets in Mehrzahl den Eichenkern durchsetzen, sich nach hinten und im grössten Theile ihres Verlaufs unmittelbar an einander haltend, um erst mit den vorderen Enden zu divergiren. Hier aus einander weichend wachsen sie in das umgebende Gewebe hinein (taf. VII, fig. 72), meist dringt einer bis zu den Integumenten vor, und dieser führt dann auch allein den aus drei Zellen bestehende Eiapparat, während es in den anderen bei einer Ansammlung formlosen Protoplasmas im vorderen Ende bleibt." In Delphinium, as previously stated, the two sacs are in contact for their entire length. The egg apparatus in each is normal and apparently well developed. Here the embryo-sacs are always covered by the nucellar cap, even after fertilization. The writer has seen in one case two embryo-sacs in *Senecio aureus*, and two in process of development in *Fagus ferruginea.*[8] The same has also been observed in *Fagus sylvatica.*[9]

Caltha palustris.—This species presents a number of interesting phenomena in the larger number of initial cells of the embryo-sac frequently met with and their subsequent behavior. The structure and development of the ovule is the same as in Delphinium, except the larger size of its cells, especially those connected either directly or indirectly with the reproductive function. The initial cell of the embryo-sac is hypodermal, sustaining a closer genetic relation apparently to this layer than to the more centrally situated cells of the nucellus. Here, however, a greater number of initial cells are present, forming in many cases what seems to be a massive archesporium. Sometimes three rather large initial cells may be seen in a longitudinal section of the ovular rudiment (fig. 11), and occasionally four or more forming a small group of

[7] Ueber Befruchtung und Zelltheilung 36.

[8] My paper, of which this species forms a part, is now in preparation.

[9] Benson, Margaret, contributions to the embryology of the Amentiferæ. Trans. Linn. Soc. Bot. II. **3**: 409-424.

cells more loosely arranged (fig. 12). The latter state of things was observed in one case only. Frequently only one initial cell could be seen, yet two were usually present. The initial cell divides by a transverse wall into two unequal cells, the lower being the larger (fig. 13). Very soon a division takes place in the lower cell (fig. 14) thus giving rise in all to three cells. It can not be said with certainty that this is always the order of division, but in the particular instances figured, there can be little doubt, for in fig. 13 the nucleus of the lower cell is in the skein stage of the prophases. In fig. 14, it will be observed that the middle cell is somewhat compressed by the enlarging mother-cell of the embryo-sac. Sometimes, however, the first division wall in the initial cell is inclined at an angle of about forty-five degrees; in other cases it was greatly arched downwards, *i. e.*, away from the apex of the nucellus, making the upper cell the larger; again a division may take place in the nucleus of the upper cell without being followed by cell-division (fig. 19). All this may take place before any sign of an integument is visible. In fig. 15 it is clear that cell-division did not follow nuclear division in the lower cell resulting from the first division of the initial cell. The two nuclei lie in opposite ends of the cell, separated by two large vacuoles. From the fact that growth is here very rapid, it may be suggested that the forces controlling nuclear division and the formation of the new cell wall were proportionately weaker than those which, at the same time, bring about the growth in size of the dividing cell. Usually the lower cell of the three becomes the embryo-sac, as in the vast majority of phanerogams, but the uppermost cell of the row may probably become the mother-cell of the embryo-sac (fig. 16). Of course, it is impossible to state definitely what would be the final result of such a condition here figured, as it was the only instance of the kind observed. The lower cell which is slightly disorganized is partly hidden by the cell above it, which in turn is somewhat overlapped by the terminal cell of the row. In this ovule the inner integument has just begun its development.

The mother-cell now develops rapidly into the embryo-sac. In fig. 17 will be seen such a cell with the remains of the disorganized cells above it. The large cell just beneath this is evidently one of the axial row of the nucellus, which failed to divide, and has become, as a result, larger than the

neighboring cells of the nucellus. Fig. 18 presents a sac with two nuclei in each end. The outer integument has now put in an appearance on the side turned from the funiculus (on the right in the figure), and the epidermis of the apex of the nucellus has given rise by periclinal divisions to a layer of three or four cells in thickness. This layer may be formed earlier in the development of the ovule (fig. 17). The embryo-sac is not infrequently mature when the inner integument has reached the apex of the nucellus. In regard to this point there is considerable variation, for both integuments may exceed the nucellus before the maturity of the embryo-sac.

The embryo-sac presents nothing abnormal. In the antipodal cells, which become quite large, the nuclei undergo fragmentation, so that each cell at the time of anthesis, contains three or four nuclei.

On account of insufficient material only a limited study of the mature sac was made. In all cases examined only one embryo-sac was found in each ovule, yet the probability is not excluded that more than one may reach maturity as in Delphinium.

Aquilegia Canadensis.—This genus, in the species investigated, presents variation in the behavior of the initial cell of the embryo-sac, along a line different from either Delphinium or Caltha. It may be stated first of all that the most striking histological phenomenon here is the smallness of the cells and consequently the small dimensions of the young ovules as compared with those of the preceding genera.

The initial cell which, of course, is hypodermal in origin, is distinguished from its neighbors of that layer only after a marked increase in size. With the growth of the nucellus it increases perceptibly in length accompanied by a similar growth in the adjacent hypodermal cells, and, in several instances observed, cuts off a small cell from the top, which seems to be a tapetal cell (fig. 20). The lower and larger cell now divides transversely (fig. 21), each of the resulting cells dividing in a similar way (fig. 22). More frequently, however, no such tapetal cell is formed, the initial producing a series of four cells in the manner described for Delphinium (figs. 23, 24). In fig. 23 the upper cell has just divided. The transverse walls are very delicate and the nuclei poor in chromatin, facts which seem to indicate that the two divisions followed in rapid succession. The lower cell (fig. 24)

has increased in size apparently by keeping pace with the elongation of the nucellus, as the cross wall separating it from the cell above is horizontal. Its nucleus is a little larger than those of the cells above, and a large vacuole occupies the upper third of the cell.

In fig. 25 it is evident that five cells have been formed from the initial cell. It is quite impossible to determine the exact order of cell-division in this case. It may have been in the manner indicated in figs. 20, 21, and 22, or the uppermost cell of the four resulting from the two successive cell-divisions (fig. 23 or 24) may have undergone a further division. Judging from my experience in this work and the appearance of the preparation from which fig. 25 was drawn, I am inclined to regard the latter process as the correct one. The condition presented by fig. 26 seems to support this view, for there can be little doubt that the uppermost cell of the series divided again at almost right angles to the usual plane of division.

The mother-cell now develops in the usual manner. When the nucellus, by lateral pressure and growth, becomes more elongated, the space occupied by the remains of the disorganizing cells is almost obliterated by the turgor of the surrounding cells (compare figs. 27 and 28). The mother-cell continues its growth mainly at the expense of the cells in front of it, and when it has reached the epidermis, whose cells have now been doubled by periclinal divisions, a nucleus occupies each end with a large vacuole between them. The further development is perfectly normal.

In the newly formed embryo-sac the antipodal cells, which are always surrounded by very evident membranes, taken together have about the same volume as the egg-apparatus (fig. 29). With the gradual increase in size of the embryo-sac prior to fertilization and some time afterwards, the antipodal cells become enormously enlarged, being very rich in protoplasm, with numerous vacuoles especially in their broad upper ends. The nuclei multiply by fragmentation.

A glance at fig. 30*a*, a small embryo with a cell by its side, probably one of the synergidæ, and fig. 30*b*, two antipodal cells taken from the same embryo-sac, will give one some idea of the phenomenon just mentioned. In this embryo-sac the endosperm consisted of many free nuclei regularly disposed in the protoplasmic lining of its cavity, *i. e.*, the endosperm is a single layer of free cells.

(To be concluded.)

The development of botany in Germany during the nineteenth century.

EDUARD STRASBURGER.

AUTHORIZED TRANSLATION BY GEORGE J. PEIRCE.

[*Concluded from p. 204.*]

The new development which systematic botany has taken on in Germany during the last decades began when new life was given to morphology by its close union with the study of the cell, with anatomy, and embryology. Schleiden had already attempted in 1845 in his "Grundzüge der wissenschaftliche Botanik," in contrast to P. de Candolle, exhaustively to characterize the main groups of the vegetable kingdom in accordance with their morphology and development. He thus gave the method which is now being employed.

It was especially Alexander Braun and his school, however, who zealously sought to develop comparative morphology, especially of flowers and flower-clusters, and to make these available for systematic botany. Among the followers of Braun, Eichler made the most important advances in the development of the system by his "Blüthendiagramme" (1875–78). Eichler improved the system established by Braun, and gave in his Syllabus a review of the whole, and an arrangement which has since then formed the basis of most lectures on systematic botany at German and foreign universities, and which is followed in botanic gardens, collections, and herbaria. Systematic botany received a mighty impulse when, at the beginning of the sixties, Darwin's works re-established the theory of descent and won for it general recognition. The construction of a system based on phylogeny now became the ultimate goal of systematic botany, and the best means of attaining this was shown to be comparative morphology. The establishment of homologies, which alone can settle systematic relationships, was now striven after. Systematic botany immediately ceased to be limited by outward form, and brought to its aid internal structure also. The main groups were characterized with a view to their anatomy, and attention was given in due proportions, even in

the single systematic tribes, to a study of the different sorts of tissue and their different modes of formation. Hugo von Mohl and Anton de Bary, the founders of comparative anatomy, may be regarded as also the founders of the anatomical method in systematic botany, the value of which was then fruitfully recognized by the systematists themselves, especially by RADLKOFER (of Munich) in Germany, and before him, though not with such insistence on this point, by Engler, Count SOLMS-LAUBACH (Göttingen, Strassburg), and Pfitzer.

The most important German contribution of recent years to systematic botany is the work edited by Engler and PRANTL[7] (Breslau) which has been in course of publication since 1889, "Die natürlichen Pflanzenfamilien." Many, for the most part German, systematic botanists united to work up the material which has been accumulated in course of time and by their own exertions, and to give a uniform presentation of the numerous families of plants in accordance with the new points of view, combining comparative morphology, development, anatomy, and the results of biological research.

The systematic study of the cryptogams shows no less advancement during recent decades than that of the phanerogams. The algæ were especially worked up by TRAUGOTT KUETZING (teacher in Nordhausen) in his "Tabulæ Phycologicæ," published from 1845 to 1870 in twenty volumes, and in numerous other works; the fungi by P. MAGNUS (Berlin), G. WINTER (a scientific man in Leipzig who held no public office, and who died in 1887), and J. SCHROETER[8] (high military surgeon in Breslau). We must thank the latter for a fungus flora of Silesia which is now nearing completion. The mosses received fundamental treatment at the hands of W. PH. SCHIMPER (Strassburg, died in 1880), and finally the vascular cryptogams by MILDE (Breslau, died in 1871) and LUERSSEN (of Königsberg).

The study of plant-geography in the German Universities attained to greater importance first under GRISEBACH (Göttingen, died in 1879). His most famous work undoubtedly is "Die Vegetation der Erde," which was published in two volumes in the year 1872. Grisebach considered climate to

[7] Died February 24, 1893.—G. J. P.

[8] Died December 12, 1894, leaving the flora still unfinished.—G. J. P.

be the most important factor in the distribution of plants. That there is, in addition to climate, a second and at least as important factor, namely the geological,—that, in other words, in order to understand the present distribution of plants, we must turn back to the floras and climatic conditions of former periods—was indeed admitted in principle by Grisebach though he scarcely noticed it in practice. This is readily explainable, since he regarded the species of plants as independent creations, and considered that variations in the species had only a limited and subordinate significance. On the other hand, the great excellences of the work were, that it gave for the first time a coherent presentation of the vegetable covering of the earth, that it divided the various floral territories into formations, and that it described the characteristic plants of each territory and formation. The later works of German investigators into the geographical distribution of plants, in contrast to those of Grisebach, are based on the theory of transformation, which here as elsewhere has shown itself to be extraordinarily fruitful. At the same time, the subject became divided into what may be called the geological or developmental, the systematic, and the biological sections. These do not antagonize one another but, on the contrary, supplement each other in giving a many-sided yet harmonious treatment of the whole.

The most important work in the geological section is by ENGLER (Kiel, Breslau, Berlin), published in two volumes in 1879 and 1882, under the title "Versuch einer Entwicklung der Pflanzenwelt." In contrast to Grisebach, the author of this book puts the factor of development in the foreground, and seeks in the past history of the present flora, the explanation of many phenomena of distribution which cannot be accounted for by the present climatic conditions alone. The purely systematic direction, which concerns itself with the present conditions of the geographical distribution of plants, and seeks to define the limits of the floral kingdom, to mark the areas of species, is cultivated mainly in the Botanical Museum at Berlin, which contains the richest herbarium in Germany. Through the activity of our explorers and colonial officials, a mass of material, rich in African species, has been gathered together in recent years, which is now being worked up by Engler, with the assistance of other experienced botanists. The results up to this time

are published partly in Engler's "Ueber die Hochgebirsgsflora des tropischen Afrikas," partly in his "Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie," which is the most important organ of this department of science. The flora of the German protectorate in southwest Africa has also been studied by SCHINZ (of Zürich). WARBURG (docent in Berlin) is the chief student of the flora of New Guinea, both as to its systematic and geographical aspects.

Still another important geographical undertaking is being directed at Berlin, namely the "Flora Brasiliensis," begun by VON MARTIUS (Munich, died in 1868), continued by Eichler, and now, under the direction of URBAN (sub-director of the Botanic Garden at Berlin), rapidly nearing completion. We are indebted for an important summary of the systematic geography of plants to a work published in 1884 by DRUDE (professor in the Institute of Technology at Dresden). By the same author, there appeared in 1890, a comprehensive "Handbuch der Pflanzengeographie" in which all parts of the field are uniformly treated.

The biological tendency in plant-geography, to explain the physiognomy of the single floras as adaptations to external conditions, was already visible in Grisebach's "Die Vegetation der Erde," but it has not received comprehensive expression. Single monographs, based on observations made in other than European countries, have been published in Germany by Schimper, Volkens, Schenck and Göbel. W. Schimper has done the most eminent work in this direction, and his experiences on his extended travels in the tropics are recorded in important and suggestive papers. The publication of these papers has followed since 1888 in the successive numbers of his "Botanische Mittheilungen aus den Tropen."

The means of aiding botanical investigation have increased remarkably in Germany during the last decades. Botanical laboratories which, in the fifties, did not exist at a single university, are now found at the agricultural schools and institutes of technology as well. The older botanists have brought about, and lived through, this transformation. De Bary, about whom in the sixties the majority of the young investigators gathered for further instruction, was the first to establish a botanical laboratory. At first at Freiburg, about 1858, it was in a low-studded room reached only by a steep dark stairway, where de Bary worked with his students Woronin,

Famintzin, and later Count Solms-Laubach. This laboratory was without separate endowment. Then, in the middle of the sixties, de Bary arranged a laboratory at Halle, roomy but as simple as possible in its arrangement, and quite unadorned. Finally, early in the eighties, he erected the laboratory at Strassburg, a handsome building, well adapted to advance scientific investigation, and expressing in its external appearance the great importance to which natural history had in the meantime attained.

Early in the sixties the botanical laboratories at Breslau, Munich and Jena were also built, and soon not only the other universities, but also other institutions of learning, followed their example. These laboratories now possess not only their own departmental libraries and the best optical instruments, but also the physical apparatus which physiological researches demand, and most of them have in addition small special green-houses connected with the buildings.

At most German universities[9] two main courses of botanical lectures are given each year, in alternate semesters: the so-called general botany, which treats of the whole field of botanical knowledge, and is designed especially to meet the needs of the medical students; and special botany, in which all the groups of the vegetable kingdom are successively treated with a view to their morphology, and also generally as regards their physiological development. Together with these main courses, which are given by the full professors, others are given by the assistant professors and the docents, on the more important families of plants or on geographical botany, with practice in the determination of plants, some also on officinal plants and on pharmacognosy especially to meet the needs of the students of pharmacy. In the free courses[10] subjects of more general interest, fertilization, pollination, adaptations, the more recent advances in the science, et cetera, are considered. Once a week, the professor or assistant professor is accustomed to conduct a botanical excursion. In the laboratory, generally twice a week, and each time for several hours in succession, there is given a practical exercise for beginners in which, at most universities, the important questions of histology are successively studied and the students are taught the use of the microscope

[9] A paper on the teaching of botany at German universities, by the translator, may be found in the Educational Review, January, 1895.

[10] For the others fees are charged.—G. J. P.

and the methods of micro-technique. For advanced students the laboratory is daily open, and there, under the direction of the teacher and his assistants, they attempt independently the solution of special problems.

Schleiden's "Grundzüge der wissenschaftliche Botanik" drove all other text- and hand-books from the field, and held for a long time its supremacy. The material to be worked over increased so remarkably during the forties and fifties, and so many new problems presented themselves, that it seemed indeed no easy task to bring everything together into a text-book. Schacht's "Lehrbuch der Anatomie und Physiologie," published in 1856, and Wilkomm's "Anleitung zum Studium der wissenschaftlichen Botanik," could not lay claim to having filled the gaps. This was first accomplished in 1868 by Sachs's "Lehrbuch der Botanik," which soon, in foreign lands as in Germany, gained the supremacy. The editions of this book followed in rapid succession, until Sachs refused to work the the book over again. A summary of Sachs's text-book by Prantl, which in its successive editions adapted itself to the developments of the science, may be regarded as the text-book which is now most widely distributed among those who are learning the science. The number of such text-books has increased remarkably of late, and an exhaustive revision of Sachs's book has been recently undertaken by Frank.[11]

The charts which now beautify the walls of almost every botanical lecture-room are indisputably important aids in teaching botany. Of these, certainly those by Kny are models. They were drawn either by himself, or under his direction, especially for teaching purposes, and were often preceded by special studies of the objects represented. The results of these investigations are presented in special pamphlets that serve at the same time as descriptions of the plates which they accompany. The wall-charts by Dodel-Port, and also those by Frank and Tschirch, are commendable and widely used. In most lecture-rooms microscopic preparations are demonstrated, and in many places, for example, at the University in Bonn, occasional hours are devoted to reviews, when the microscopic figures are projected by means of a solar microscope. In other places, the electric light is used for the same purpose, or the photogrammes by L. KOCH (of Heidelberg), are thrown upon the screen by the sciopticon.

[11] This has now appeared in two volumes.—G. J. P.

Hugo Mohl was himself able to grind lenses. In various papers he instructed his contemporaries as to the manipulation of the microscope, and finally in his "Micrographia" gave exhaustive directions for its use. Schacht published a book on the microscope in 1862, whose chief value lay not so much in its optical part as in the directions for the study of specified vegetable objects. On the contrary, in Naegeli and Schwendener's "Das Mikroskop" the optical and purely physical portion of the subject was put in the foreground, while Dippel's work, "Das Mikroskop," published in 1867 and 1869, occupies the middle ground between the two preceding. Strasburger confined himself to the botanical part of the problem in "Das botanische Praktikum," which appeared in 1884 in a large edition for advanced students, and in a smaller one for beginners. This practical botany attempts to conduct the learner through a series of problems covering the entire field of microscopical botany, and to make him familiar with the use of the instrument and with microscopical technique. The structure and use of the microscope and botanical microtechnique are taught without the consideration of special objects for study by Behrens's "Leitfaden der botanischen Mikroskopie," published in 1890. His "Tabellen zum Gebrauch beim mikroskopischen Arbeiten," treat only of technique, and the same may be said of the "Botanische Microtechnique,"[12] by ZIMMERMAN[13] (docent in Tübingen), published in 1892.

The numerous botanical journals now appearing give eloquent testimony to the activity of botanical research in Germany. "Flora" has been published since 1818 by the Botanical Society in Ratisbon.[14] The "Botanische Zeitung" was founded in 1843 by Mohl and Schlechtendal. The "Jahrbücher für wissenschaftliche Botanik," for more comprehensive papers, have been published since 1858 by Pringsheim and are now before us in twenty-three constantly enlarging volumes. In the seventies most of the botanical laboratories of the German universities began to publish their researches in journals of their own. In addition, many botanical papers have been, and continue to be, published in the Nova Acta of the Leopold-Caroline Academy and in the Proceedings of other Academies. Since 1881 the "Botanische Jahrbücher für System-

[12] Translated by J. E. Humphrey, and published by Henry Holt & Co.—G. J. P.
[13] Now raised to the rank of assistant professor.—G. J. P.
[14] Edited since 1889 by Professor Karl Goebel of Munich.—G. J. P.

atik, Pflanzengeschichte und Pflanzengeographie" have regularly appeared under Engler's editorship, and have already reached the imposing number of thirteen volumes. It presently became impossible for any one to master the whole botanical literature, and so there was established in 1873 an organ for reviews, Just's "Jahresbericht," which appears yearly in two volumes and gives accurate abstracts of the contents of those botanical writings which have appeared in the course of a year. The "Botanisches Centralblatt," edited by Uhlworm, began in 1880, and is now completing its fifty-second volume. Owing to the enormous amount of material for publication, it has just been decided to issue supplements to this.

An important event in the life of botanical science in Germany was the founding, at Pringsheim's suggestion, of Die deutsche botanische Gesellschaft, of which Pringsheim has since been the President. German botanists, almost without exception, have joined this society, and many notable foreign botanists also, in addition to those who have been selected by the society as honorary or corresponding members. The society holds its regular monthly meetings in Berlin, the chairman of which is chosen yearly from among the Berlin botanists. A general meeting is also held each year, which until now has always been in conjunction with the Versammlung deutscher Naturforscher und Aerzte. The papers read or presented at the meetings are published in the "Berichte der deutschen botanischen Gesellschaft." A special commission under the chairmanship of C. ASCHERSON (Berlin), well known for his knowledge of the German flora, makes its yearly report on this subject at the general meeting. Der botanische Verein für die Provinz Brandenburg, also maintained in Berlin, especially cultivates the interests of systematic botany and publishes its proceedings.

The botanical laboratories, which soon became the centers of botanical work in the higher institutions of learning, at first somewhat overshadowed the botanic gardens in importance. Since then, however, most of the German botanic gardens have adapted themselves to the new problems of the science, and now actively supplement the physiological teaching by special displays of so-called biological groups of plants. The increasing interest in systematic botany has revived the interest in the plants themselves, and it is the botanic gardens

which aid one to form a conception of the most varied plant-forms of our globe. As experimental and acclimatization gardens they are now called upon to advance colonial interests, and have as their model the magnificent achievements in which the Botanic Garden at Kew, near London, may justly take pride. The botanic gardens must not be underestimated as a means of educating the general public; for it is by such establishments that our institutions of learning may keep in closest union with the unprofessional world which seeks further instruction.

The imposing edifice of the Botanical Museum at Berlin gives highly honorable testimony, as do the other museums established during the last ten years, to the noble efforts of the Prussian ministry. This botanical museum, scientifically arranged by Eichler, is now brilliantly developing under Engler's direction. It furnishes the center of fruitful opportunities for the growth of all botanical science in Germany, and, what will contribute not a little thereto, preserves for Germany the botanical treasures from foreign lands.

Bonn, Germany.

Musineon of Rafinesque.

JOHN M. COULTER AND J. N. ROSE.

In studying some recent Mexican collections of *Umbelliferæ* we were led to an investigation of the genus commonly known as *Musenium* of Nuttall by the discovery of what seems to be a Mexican representative of it. The Nuttallian genus of 1840 had been replaced by Rafinesque's *Adorium* of 1825 in Kuntze's *Revisio*, and this name appears in the recent "Check list" published under the auspices of the Botanical Club. As the validity of this substitution must rest upon a thorough examination of Rafinesque's writings, advantage was taken of the unusual facilities offered by the various libraries at Washington to examine into the matter. The result is stated in the following history:

In 1819, in *Journal de Physique, de Chimie et d'Histoire Naturelle* (**89:** 101), Rafinesque established the genus *Marathrum*, basing it upon *Seseli divaricatum* Pursh.

In 1820, in the same journal (**91:** 71), having discovered a previously described *Marathrum* Humb. & Bonp. (1808), he substituted *Musineon* for his *Marathrum*, and as this publication seems to have escaped the notice of recent bibliographers, Rafinesque's statement is quoted in full as follows:

1. Dans le prodrome de 50 nouveaux genres de plantes d'Amérique, j'ai décrit deux nouveaux genres sous les noms de *marathrum* et de *pythagorea;* je me suis aperçu depuis lors, que ces noms avaient déjà été employés, le premier par Robert Brown, et le second par Loureiro; et comme je suis convaincu de l'importance et de la nécessité d'éviter des doubles emplois en Botanique, je m'empresse de rectifier cette erreur, et de proposer les noms suivans en place.

Mon G.[1] *marathrum* devra se nommer *musineon.* Ces deux noms sont des synonymes de fenouil.

In 1825 Rafinesque suggested still another name, *Adorium*, which was taken up by Dr. Otto Kuntze as the oldest tenable name, who states that the *Musineon* Raf., referred to in DeCandolle's Prodromus (**4:** 146), must be an error. Dr. Kuntze certainly did not find it in the place cited in the *Revisio*, for it is the citation of *Marathrum.*

[1] With Rafinesque the abbreviation "G" stands for genus.

In 1840, among Nuttall's manuscript genera, Torrey and Gray published *Musenium*, which was evidently simply a Latinizing of Rafinesque's *Musineon*, with which Nuttall was certainly familiar.

It seems clear, therefore, that the generic name *Musenium* must stand, but that it is not Nuttall's, and should retain the form *Musineon* originally published by Rafinesque.

Our present understanding of the genus and its species is as follows:

MUSINEON Raf. Jour. Phys. **91:** 71. 1820.

Marathrum Raf. Jour. Phys. 89: 101. 1819. not H. & B. 1808.
Adorium Raf. Neogenyt. 3. 1825.
Musenium Nutt. Torr. & Gray, Fl. 1: 642. 1840.

**Calyx-teeth prominent: carpophore entire.*—Rocky Mts. and plains to the eastward from Colorado northward.

\+ *Stems dichotomously branching from the base: leaf-segments toothed.*

\+\+ *Stems glabrous: fruit smooth, about 4^{mm} long.*

1. MUSINEON DIVARICATUM (Pursh.) Raf. Journ. Phys. **91:** 71. 1820.

Seseli lucidum Nutt. Fras. Cat. (1813), name only.
Seseli divaricatum Pursh. Fl. 723. 1814.
Marathrum divaricatum Raf. Journ. Phys. 89: 101. 1819.
Adorium crassifolium Raf. Neogenyt. 3. 1825.
Adorium lucidum Kuntze, Rev. Gen. Pl. 264, 1891, name only.
Adorium divaricatum Rydberg, Bot. Surv. Nebr. 3: 37. 1894.

\+\+ \+\+ *Stems scabrous: fruit scabrous, shorter and broader than in the former.*

2. MUSINEON HOOKERI (Nutt.) Torr. & Gray, Fl. **1:** 642. 1840.

M. divaricatum Hookeri T. & G. l. c.
M. trachyspermum Nutt. l. c.
M. angustifolium Nutt. l. c.

\+ \+ *Acaulescent, the simple peduncles much exceeding the leaves: leaf-segments narrowly linear and entire.*

3. MUSINEON TENUIFOLIUM (Nutt.) Torr. & Gray, Fl. **1:** 642. 1840.

Adorium tenuifolium Kuntze, Rev. Gen. Pl. 264. 1891.

** *Calyx-teeth obsolete: carpophore two-parted.*—High mountains of southern Mexico.

4. **Musineon alpinum,** n. sp.—Acaulescent, in dense mats, from a thick branching caudex, 5 to 10^{cm} high, glabrous throughout, or nearly so: leaves once to twice pinnate, somewhat shorter than the peduncles, the primary segments ovate and more or less lobed or pinnately parted, and usually with a pubescent ring on the rhachis at the junction: peduncles thick, bearing a few-flowered 4- to 6-rayed umbel, with no involucre and involucels of few linear bractlets longer than pedicels: rays unequal, 6 to 12^{mm} long: pedicels 2 to 4^{mm} long: flowers not seen: fruit glabrous, oblong-ovate, with notched base and blunt apex, 3^{mm} long, with filiform ribs and long, flat (strap-shaped) styles.—Cold summit slopes, Nevada de Toluca, state of Mexico, alt. 14,000^{ft}, September 2, 1892, *Pringle's* no. 4,247 of 1892.

This species is referred to *Musineon*, although it is widely separated geographically from the other species, which belong to the northern plains region. Its habit and general characters are those of the genus as already known, but the obsolete calyx-teeth, two-parted carpophore, and peculiar styles, as well as the wide geographic separation, suggest a possible generic separation if supported by further Mexican material. The fact that it occupies the high mountain region of Central Mexico makes its claim to be congeneric with the northern forms more reasonable.

Lake Forest and *Washington.*

The nomenclature question.

On the application of "once a synonym always a synonym" to binomials.

Reviewing in the March number of the GAZETTE the recently published "List of Pteridophyta and Spermatophyta," I made the following statement: "It will always be possible for an erratic botanist to throw together large genera like *Aster* and *Erigeron*, *Bidens* and *Coreopsis*, *Panicum* and *Paspalum*, thereby displacing [in accordance with the Madison rules] many specific names which according to the rule of once a synonym always a synonym can never be revived." Criticising my position Mr. Coville in the April number of this journal pronounces this a lamentable error. Although he has quoted my statement accurately he appears to have overlooked the important word "*specific*," which it contains, since to prove its deplorable inaccuracy he advances merely some well-known and wholly irrelevant generalizations regarding *generic* names. Although it should have been clear to every careful reader that the case under discussion had to do with specific names, the point which I wished to make is somewhat technical and perhaps should have further elaboration.

When two large genera, like *Cacalia* and *Senecio*, or *Carduus* and *Cnicus*, are united, a certain number of valid species of like specific name are brought under the same generic name and a part of them of course must receive new specific names. If now the same genera are separated the question of the restoration of the displaced specific names arises at once and on this point the Rochester and Madison rules appear to lead to a curious dilemma. This can only be made clear by examples.

Let us suppose that *Panicum* and *Paspalum* are united by A in 1895 under the former name. As there are at present both a *Panicum dissitiflorum* Steudel (1841) and a *Paspalum dissitiflorum* Trinius (1826), it is evident that one must be renamed. At Madison it was decided that in such cases it is not the age of the combination but the age of the specific name which should be the determining factor, so that the *dissitiflorum* of Trinius would have preference even under

the changed generic name, and A would accordingly rename *Panicum dissitiflorum* Steud.; the two species thus becoming, we will say, 1. *Panicum dissitiflorum* (Trinius) A. 1895. = *Paspalum dissitiflorum* Trinius. 1826. 2. *Panicum Steudelii* A. 1895. = *Panicum dissitiflorum* Steudel. 1841.

Suppose that in 1896 B separates the two genera. May he, according to the Rochester and Madison rules and the principle of once a synonym always a synonym, re-instate *Panicum dissitiflorum* Steud.? Discussing this point at Madison with a member of the nomenclature committee, I was informed that a name so displaced could never be re-established, since, to continue our example, there exists in 1896 a *Panicum dissitiflorum* (Trin.) A, with an older specific name than *Panicum dissitiflorum* Steud. Now this interpretation of the rules must be either right or wrong. If it is correct I must reiterate that it would give to any erratic writer the power of forever displacing valid specific names, since there is no limit to which large related genera can be brought together, and the Rochester and Madison codes do not permit exceptions and least of all personal distinctions in the application of their rules, so that it would make no difference whatever who united the genera or whether he had any real scientific basis for his judgment. If, on the other hand, the interpretation is wrong and my informant was in error, it is certainly an unfortunate rule which is not uniformly understood even by all the members of the committee that frames it. And furthermore, if we admit that *Panicum dissitiflorum* Steud. could be restored, does it not show inconsistency in the application of the rules? For in uniting the two genera it is the age of the specific names, as we are told, that determines which of two specific homonyms may stand. In separating the same genera and applying the principle of once a synonym always a synonym this factor would be totally neglected and a species would be re-instated notwithstanding the fact that there would be an older and identical specific name at that time in the genus. It is worthy of note that in this matter as in some others the uniform adoption of the first correct combination—a most healthful check to the undesirable effects of unlimited priority—would readily obviate the difficulty.

Considering the fact that the "List of Pteridophyta and Spermatophyta" has not, to my knowledge, received as yet the formal sanction of any considerable or representative body of

American botanists, and that its intent, as understood by many members of the Botanical Club of the American Association and by some at least of the nomenclature committee, was not to establish the Rochester and Madison rules but to show their outcome and give a better basis for their discussion, I must express considerable surprise at the following sentence of Mr. Coville's criticism of my review: "Now that they [the principles] have been adopted by overwhelming majorities in democratic botanical assemblages, we may ask whether Dr. Robinson's protest is not out of place." Certainly to object to the discussion of this subject and to rule out the expression of any opinion at variance with the new rules is as unscientific as it is undemocratic.—B. L. ROBINSON.

Recommendations regarding the nomenclature of systematic botany.

[A circular with the above title has recently been issued by Dr. B. L. Robinson, curator of the Gray herbarium. We republish the recommendations, omitting the prefatory remarks and arguments. The paper is signed by seventy-four botanists "of various degrees of repute"—to use Mr. Rand's expression regarding the supporters of the Rochester agreement.—EDS.]

1. Ordinal names, having been established by long usage, should not be subjected to revision upon theoretical grounds.

2. Long-established and generally known generic names . . should be retained. The scope of this rule is left to the discretion of writers. . . .

3. In specific nomenclature the first correct combination is to be preferred. . . For these reasons it seems best to adopt the principle of priority under the genus. It is to be emphasized, however, that this ruling does not lessen the obligation of botanists of the present and future in making a transfer of a species from one genus to another to preserve scrupulously the specific name without alteration, except in the case of an existing homonym.

4. The varietal name is to be regarded as inferior in rank to the specific. . . . No specific name should be altered, because of preexisting varietal names for the same plant. Nevertheless, it is recommended as a working rule that whenever a variety is raised to specific or a species depressed to varietal rank the name should be preserved whenever possible.

5. The principle of "once a synonym always a synonym," while recommended as an excellent working rule for present and future, may not justly be made retroactive.

The botanical work of the government.

JOHN M. COULTER.

The amount of botanical work that has been undertaken by the national government is perhaps unknown to all except those who come in direct contact with it. Thinking that such information would not only be of interest to botanists in general, but would also be of service to the work itself, the chiefs of the various divisions were asked to furnish the following information, which was given very promptly and courteously. At present four distinct divisions of botanical work are organized under the Department of Agriculture, although other divisions also do a certain amount of work that may be fairly called botanical.

1. DIVISION OF BOTANY. The total appropriation for the Division of Botany for the year ending June 30, 1895, is $38,600. The appropriation made for the year ending June 30, 1896, is $33,800, the new Division of Agrostology having been separated from the Division of Botany, as indicated below. The employees who are engaged in strictly scientific work, exclusive of those engaged in semi-technical, editorial and clerical work, and the temporary field agents, who are employed only during the collecting season, are as follows:

Mr. Frederick V. Coville (Cornell University), as chief of the division, is engaged principally in its administrative work but is also doing some monographic and local botanical work on plants of eastern Washington and eastern Oregon.

Mr. J. N. Rose (Wabash College), as assistant botanist and honorary assistant curator, has general charge of the herbarium, makes the majority of critical miscellaneous identifications, and is also engaged in working upon collections of Mexican plants.

Mr. L. H. Dewey (Mich. Agric. College) is engaged upon investigations of weeds, collating information of all kinds regarding them; and combining this information into form for popular use.

Mr. G. H. Hicks (Mich. Agric. College; Univ. of Michigan) has charge of the pure seed investigations of the Division, maintaining and adding to the collection of seeds, and

testing commercial samples with reference to their purity and germinative capacity.

Mr. C. L. Pollard (Columbia College) is acting as assistant curator of the herbarium, and is engaged at present in numbering specimens already mounted, distributing newly mounted material, and arranging the plants properly upon the shelves.

Mr. A. G. Pieters (Mich. Agric. College; Cornell Univ.) is acting as an assistant of Mr. Hicks, and is engaged particularly in making germination tests of commercial seed.

Mr. V. K. Chesnut (Univ. of Calif.; Univ. of Chicago) is engaged upon an investigation, both pharmacological and physiological, of poisonous and medicinal plants.

Mr. Marcus E. Jones (Iowa College) is engaged in working up a report on the collection of plants made by him in southern Utah and northern Arizona during the season of 1894.

Messrs. Scribner, Kearney and Smith are also connected with this Division until July 1, but their work will be mentioned in connection with the new Division of Agrostology.

The work of the Botanical Division during the coming year will in the main be an amplification of the lines of work already under way, and possibly the assumption of one or two additional investigations.

2. DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY. It will be noted that "Physiology" has been added to the title of this Division by the last Congress, enabling work which had already been begun to be prosecuted upon a broader basis, and recognizing the fact that in the study of diseased plants the normal life processes must first be understood before the diseased organism can be studied intelligently. The appropriation for the year ending June 30, 1895, was $26,100; for the year ending June 30, 1896, it is $26,300. The care of the extensive collection, correspondence and system of indexing is shared by all the staff at Washington. The laboratory investigations are conducted at Washington, Eustis (Fla.) and Santa Ana (Calif.), and are in charge of the following staff:

Mr. B. T. Galloway (University of Missouri), as Chief of the Division, has charge of the administrative work, general direction of all investigations, and edits all bulletins and reports. In such time as is left to him, he is investigating the conditions affecting the health of plants under glass, and also one or two groups of fungi.

Mr. Albert F. Woods (University of Nebraska), Assistant Chief, is engaged in an investigation of the growth of potatoes as affected by spraying with Bordeaux mixture, it having been found that the effect is wholly distinct from that resulting from the prevention of insect and fungus attacks, often causing an increased yield of from 30 to 50 per cent.

Mr. Erwin F. Smith (University of Michigan) is a student of peach yellows and bacterial diseases, and is now continuing his investigations of the melon diseases, especially those prevailing in the south.

Mr. M. B. Waite (University of Illinois) is investigating diseases of pomaceous fruits and is now studying pear blight, chiefly with reference to the effect of different fungicides, the effect of different degrees of heat and cold, and is making bacteriological studies of insects found on the pear or known to visit it.

Mr. W. T. Swingle (Kansas Agric. College), stationed at Eustis, Florida, is studying the diseases of citrus fruits and other subtropical plants, and is now investigating the blight, die-back, sooty mold and scab of the orange and other citrus fruits.

Mr. H. J. Webber (University of Nebraska) is associated with Mr. Swingle in these studies.

Mr. Newton B. Pierce (University of Michigan), stationed at Santa Ana, California, is investigating the diseases of the grape and other fruits on the Pacific Coast.

Mr. M. A. Carleton (Kansas Agric. College) is investigating the diseases of cereals, especially the rusts and smuts.

Mr. Theo. Holm (University of Copenhagen) has charge of anatomical work, is now examining the anatomy of galls, and will soon take up a study of the anatomy of cultivated wheats in relation to rust-resisting qualities.

Mr. Joseph F. James has charge of the herbarium, and also general supervision of the index work.

Mr. P. H. Dorsett (University of Missouri) has charge of field work with fungicides.

Nearly all of this staff are also interested in various groups of lower plants, but no attempt is made to push this work to the front. Primarily the work is on the physiology and pathology of plants in relation to agriculture, purely systematic studies being secondary.

3. DIVISION OF AGROSTOLOGY. This is a new division

established by the last Congress, but the act does not go into effect until the first of July. Until that time the work is a part of that of the Division of Botany. The function of the new division, which deals with forage plants as well as grasses, is to instruct and familiarize the people with the habits and uses of these plants, to conduct investigations relative to their natural history and adaptability to different soils and climates, to introduce promising native and foreign kinds into cultivation, to identify all grasses and forage plants sent in for identification, and reply to all correspondence relative to these plants. For this work $15,000 has been appropriated, and the following staff has been provided:

Professor F. Lamson-Scribner, Chief of the Division. Professor Scribner is now engaged in the preparation of a Handbook of the Grasses of the United States, in which it is designed to describe and illustrate all of our species of grasses. The illustrations thus far prepared are of the highest order of excellence.

Mr. T. H. Kearney, Jr. (Univ. of Tennessee; Columbia College), is assisting Professor Scribner on the Handbook.

Mr. Jared G. Smith (Univ. of Nebraska) will have direct charge of the outside work of the Division.

4. DIVISION OF FORESTRY. This Division is in a somewhat different position from all other Divisions in that they deal with existing interests, while the Forestry Division has still to create an interest in its subject. Besides scientific investigations, therefore, a considerable amount of propaganda work is carried on and the scientific work has until lately been rather on uncertain lines and desultory. Within the last three years, however, a more definite policy in this respect has been inaugurated and systematic work is carried on, having in view the laying of a theoretical basis for future forestry practice.

Mr. B. E. Fernow, as Chief of the Division, has charge of the administrative work, and also is very actively engaged in arousing and organizing public sentiment in favor of a rational forestry policy.

Mr. Chas. A. Kieffer (Iowa Agric. College) is Assistant Chief, and in addition to his official duties is charged with all questions relating to western tree planting, and especially with conducting a series of forest planting experiments in co-operation with agricultural experiment stations in Kansas, Nebraska, the Dakotas and Colorado.

Mr. Geo. B. Sudworth (Univ. of Michigan) has charge of the strictly botanical work, identifying all species, and answering economic questions of adaptation of species to climate and soils.

Dr. Charles Mohr is a field agent, who has not only collected material for timber test work, but has also prepared monographs on the southern coniferous trees of commercial value.

Mr. Austin Cary (Bowdoin College) is also a field agent, who has been engaged on tree measurements to establish the rate of growth and wood production of various species, notably the black spruce in Maine and New Hampshire, and the white and Norway pine in Michigan and Wisconsin.

The main work of the Division for the last three years has been in the line of "timber physics," *i. e.*, the study of the character and value of the wood of our merchantable species. For this purpose logs and disk pieces are collected with care of the various species from the various localities and soil conditions in which they occur; the two field agents, Dr. Mohr and Mr. Cary, having done most of the collecting. The log material goes to the Testing Laboratory of the Washington University of St. Louis, where it is subjected to various tests systematically under the direction of Mr. J. B. Johnson, the professor of engineering in the University. The physical examination is in charge of Mr. Filibert Roth (Univ. of Michigan).

The monographs of Professor Spalding on the white pine, Professor Prentiss on the hemlock, Professor Flint on Pinus resinosa and P. rigida, and Miss Kate Furbish on Picea nigra, still await publication.

Such is a bare outline of the botanical work carried on by the Department of Agriculture, but it will serve to show its general scope. It will also serve to direct inquiry concerning various subjects to the proper sources of information, and indicate in many cases the proper destination of material.

Lake Forest, Ill.

BRIEFER ARTICLES.

Abnormal fruiting of Vaucheria. (WITH PLATE XXI.)—In specimens of *Vaucheria geminata*, var. *racemosa*, brought into the laboratory in October, 1894, some interesting cases of abnormal fruiting organs were observed. The material was collected in the grassy flats of Cayuga lake, at a spot covered by the overflow of a small stream.

The variations from the normal were frequent, and included three general types:

1. Those in which the oogonia were aborted, leaving on the fruiting branch stump-like protuberances.

2. Those in which the oogonia were prolonged into vegetative filaments.

3. Those bearing fully developed antheridia in places normally occupied by oogonia.

Numerous combinations of these types with different intermediate forms were also present.

The first case is inconspicuous, and admits of some doubt, inasmuch as the stumpy protuberances closely resemble branches from which oogonia have fallen. In certain specimens, however, the peculiar shape of the end of the stump, its unusual length, and the entire absence of any trace of a broken sheath, such as is usually left by a fallen oogonium, furnish conclusive evidence that the female organ has not been present. Whether the rudiment represents an oogonium or an adventitious antheridium, such as is described in type three, it is impossible to determine.

The second type shows close analogy to conditions found in different fungi, notably the Saprolegniaceæ. The vegetative filaments arise sometimes from the apex of an oogonium, sometimes directly from the pedicel, thus replacing the oogonium. They are usually narrower than the mother filament, but in cases which seem to be intermediate between this and the first type, the young filaments have a diameter equal to that of the pedicel from which they arise. Different forms of this type are described and figured by Campbell in the *American Naturalist* for June, 1886, from observations made on artificial cultures.

The third case presents a somewhat more remarkable condition, but one to which a partial analogy may be found in ferns, where rudimentary prothallia, from crowding or insufficient nutriment, produce only antheridia. Reasoning from this analogy, we are led to assume that the filaments of Vaucheria upon which such fruiting organs are

produced must have grown under starved conditions, or, for some other reason, have not exercised a normal vegetative function. In the appearance of the plants we find nothing either to confirm or deny this assumption. In some cases, it is true, the filaments bearing such organs were more or less disorganized, the chlorophyll scanty and aggregated in broken masses. In other filaments, however, upon which the fruiting branches were equally deformed, the chlorophyll was in a healthy condition, and the filaments had every appearance of thrift and vigor. Moreover, on filaments wholly destitute of chlorophyll and partially disorganized, perfectly normal fruit bodies appeared. But these appearances become totally irrelevant to our conclusions when we remember that the non-septate structure of these plants permits free circulation from filament to filament through long distances, and hence the chlorophyll conditions may become conspicuously altered, in a certain part of the plant, after the development of the fruit branch.

In order, then, to prove the relation of growth conditions to this abnormal development, it remains to be shown, first, what were the conditions of growth under which this occurred; second, that similar conditions will produce similar results; and, third, that opposed conditions tend to prevent such development. As to the first we know only that the plants grew floating in the water of a flooded marsh, not in contact with the soil, and bathed, presumably, by comparatively clear water, since they floated above a toughly sodded bed. We also know, from experiments, that these same plants grown in vessels of clear water in the laboratory, continued to produce abnormal fruit. No experiments have been made to prove that normal plants would degenerate if grown in the same way.

As to whether the same material grown on moist earth or in less crowded masses would behave differently, we have no definite experimental knowledge, and hence, on the whole, are not warranted in asserting conclusively the relation of this peculiar development to growth conditions.—Mary A. Nichols, *Cornell University*.

Explanation of Plate XXI.—Fig. 1 shows a mixed type, *r*, *r*, being rudimentary organs either male or female, described under type 1, and *a*, *a*, antheridia developed in place of oogonia (type 3).

Fig 2 illustrates another form of types 1 and 3. *r*, rudiment; *a*, *a*, antheridia.

Fig. 3 shows type 3 bearing three antheridia, and no oogonia, or perhaps very rudimentary ones, at *r*, *r*, *r*.

Fig. 4 shows parent branch and lateral bud, each bearing one antheridium only; *b*, a broken branch, leaving no indication of its nature.

Note.—Such cases as that shown in Fig. 1 leave room for suspicion that the branches *a*, *a*, are not simple antheridia, but lateral buds similar to that of

Fig. 4, upon which no oogonia have developed. Cases like that shown in Fig. 3, however, and another case observed (of which, unfortunately, no camera-lucida sketch could be secured), which bore a whorl of six antheridia, exactly corresponding in position to the normal oogonia, belong certainly to type 3, as given.

Astragalus Blakei n. sp.—*A. Robbinsii borealis* n. var. in MS. and herbarium, 1894.

A. Robbinsii Gray's Man., 2nd ed. (1856.)

A. alpinus L. Gray's Man., 3rd ed. (1862.)

Perennial, *few* to many stemmed, from a fibrous knotty root deeply fixed in the cliffs.

Stems 3–5^{dm} high, *erect*, sometimes slightly decumbent at base, sparsely pubescent, slightly angular, twisted, striate.

Stipules erect, upper ones becoming deflexed, triangular ovate, acute or obtuse, 4–6^{mm} long; leaves 3–10^{cm} in length, with from 5–8, generally 6–7, pairs of leaflets; leaflets opposite or nearly so, on petioles about 2^{mm} long, oblong, elliptical, the middle ones larger and the upper ones generally decreasing in size faster than the lower, obtuse and frequently emarginate, green and glabrous above, mealy pubescent beneath, with white appressed hairs, becoming more glabrous with age.

Peduncles *one or two*, 10–25^{cm} in length, very erect, twisted striate, nigrescently pubescent.

Raceme ovate, becoming oblong and loose, 5–15 flowered.

Flowers about 8^{mm} long, pedicels often equalling or exceeding the length of the calyx.

Bracts linear, acute about half as long as the pedicels, calyx tubular campanulate, nigrescently hairy, the linear bluntish teeth more hairy and one-third the length of the calyx. Corolla strongly resembling that of *A. Robbinsii*, light violet or sometimes white with the keel tinged with violet or purple. Legume 8–25^{mm} in length, *horizontal, triangular-turgid*, oblong and obtuse or acute at both ends.

Stipe shorter than calyx, thickly pubescent with whitish or nigrescent hairs slightly transparent, tipped with the recurved persistent style, *both sutures* curved, *dorsally* sulcate, often but slightly so, 4–8-seeded.

Type stations: Willoughby Mt., Smuggler's and Nebraska Notches, Vt., Willoughby Mt., Westmore, Vt. Rev. Joseph *Blake* (previous to 1856), etc. Smuggler's Notch, Mt. Mansfield, Stowe, Vt., C. G. *Pringle*, etc., Nebraska Notch, Mt. Mansfield, Underhill, Vt., C. G. *Pringle* and F. H. *Horsford*. Fort Kent, St. John River, Maine, Miss Kate *Furbish*.

Specimens of the Rev. S. R. *Butler* from Forbeau, Labrador, of J. *Macoun* from the western mountains, and of W. H. Dall from Alaska appear to be of this species.—W. W. EGGLESTON, *Rutland, Vt.*

EDITORIAL.

PROFESSOR GREENE indulges in some characteristic hypercriticism in connection with the rules for citation adopted by the Madison Botanical Congress and Section G, A. A. A. S. Without finding fault with the rules themselves (for which relief much thanks), he takes a page to pick flaws in the abbreviations used in the examples which are supplied for the convenience of readers in interpreting the rules. Had Professor Greene even taken occasion to read the rules and the reference therein given, he would have seen that the abbreviations of authors' names, journals, etc., to be used in citation have not yet been reported upon by the committee. Criticism of this sort is an expression of querulousness, and degenerates into mere faultfinding, "as any accomplished bibliographer would readily perceive." We may, without offence we hope, remind Mr. Greene that kindliness of word and charitable judgment are vastly more effective than the petulance of this criticism or the rancor of his ungentlemanly attack on Mr. Sheldon in the same number of *Erythea*.

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ON THE INSIDE page of the cover of *Grevillea* the following appears as a standing notice: "Specimens of cryptogamic plants will be named for students. The plants must be carefully packed and numbered and postage enclosed for reply." Then follow the names and addresses of those to whom they are to be sent, and the notice concludes thus: "This applies to students only who show by accompanying notes a desire to work. Wholesale batches, sent merely with the object of forming a 'list', will not be countenanced." While none of our editors in this country is perhaps ready to make such an announcement as a personal matter, this notice really contains a hint for American students. It may be taken for granted that those named in connection with the Systematic Botany of North America (see this journal 20: 177. Ap. 1895) stand ready to receive material under the conditions named above and to determine it for correspondents. It certainly ought not to be necessary to send material abroad for determination, which some collectors seem altogether too ready to do. It is not selfishly that we remonstrate against this. The existence of type specimens of American plants in the public herbaria of the United States ought to be assured by having the new plants sent to American students for study. We hope that our collectors will see to it that they do not increase the number of inaccessible foreign types.

CURRENT LITERATURE.

A text-book for advanced students.[1]

In the second half of Vines' "Student's Text-Book of Botany," recently issued, two-thirds of the space is given to the discussion of phanerogams, which concludes part III of the four grand divisions of the book. The presentation of the phanerogams is not characterized by any novelties in the way of changes in classification, but rather by a conservative retention of the older views. In the present state of our knowledge of relationships perhaps this is the only safe course, but one cannot help wishing that the dicotyledons had not appeared under the old three-fold division. This, however, has been suggestively modified, for the old group *Apetalæ* has been broken up; those in which the flower has become simple by suppression being intercalated among the *Polypetalæ;* and those which are regarded as primitively simple forming the group *Monochlamydeæ.* For example, *Euphorbiaceæ* appear among *Polypetalæ,* while *Chenopodiaceæ* are retained among the *Monochlamydeæ.* Theoretically the distinction is a good one, but the difficulty of determining what groups are primitive and what groups are reduced is a large practical objection.

Aside from the fact that our most recent knowledge of morphology is incorporated, and so the whole presentation enriched, the notable feature is the maintenance throughout of a consistent morphological terminology. Sporophyte and gametophyte are discussed separately, and their structures are so designated as to keep homologies clearly in view. By no means the least important part of the work is the excellent summary given in each great group of the histology and embryology of the sporophyte. Probably the most perplexing morphological problem that remains among angiosperms is that concerning the nature of the structures of the embryo-sac, and one always turns with interest to this subject in a new book. Dr. Vines has adopted the view that the prothallium of angiosperms is developed in two stages, separated from each other by the act of fertilization; that is, that the "endosperm" is simply a later development of the prothallium. It is true that there are other prothallia which continue to develop after the oospheres have been fertilized, but there remains yet to be ex-

[1] VINES, S. H.—A student's text-book of botany (second half). 8vo. pp. 431–821, figs. 280–483. London: Swan Sonnenschein & Co. New York: Macmillan & Co. $2.00. (See for notice of first half, this journal, **19:** 202. 1894.)

plained the significance of the formation of the endosperm nucleus, and the relation of its segmentation to the act of fertilization. The strong development of the antipodal region in certain groups, is a fact coming into such prominence that the old statements concerning it should certainly be modified.

The presentation of phanerogams is certainly a botanical treasure house, full of the latest and best that is known concerning the subject. From the teacher's standpoint the only criticism to be offered is lack of organization. It is difficult for the reader, who is not already a botanist, to grasp the really salient things and separate them from the rest. If the book were a picture one might say that the perspective was bad. With the living teacher such an objection disappears, and in any event is far overbalanced by the fullness and freshness of facts and terminology.

When we turn to part IV, on physiology, we find Dr. Vines at his best, and cannot help regretting that he did not restrict the treatment of phanerogams (which covers nearly 230 pages) to a discussion of the "orders" at least or even to his "cohorts," and thus leave himself room for a fuller discussion of physiological questions. We must however make the best of the 118 pages which he devotes to these topics. No fault can be found with the way in which he has utilized these all too few pages. The matter is logical, clear, well-balanced. The most notable departure from his "Lectures on the Physiology of Plants" is to be found in the parts on the special physiology of the nutritive functions and reproduction. Here Vines distinctly recognizes the manufacture of carbohydrates as a distinct process, to which however he gives no name, designating it merely as "the first step in the process of assimilation." He abandons also the idea that carbohydrates arise in the course of assimilation by a katabolic process, saying "the product of this carbon-assimilation is . . . a non-nitrogenous organic substance having the composition of a carbohydrate."

It need hardly be said that in each of the four chapters, on general physiology, and on special physiology of the nutritive functions, movement and reproduction, the matter has been brought down to date. On the whole the work must be looked upon as one of the best reference books in our language, and, with judicious selection by a good teacher, one of the best texts for advanced readers.

Horticultural botany.

Of all who deal with plants probably the horticulturist and florist come to the most intimate knowledge of certain phases of vegetable life. The success of their daily toil and the year's profits depend

upon their recognition of the material needs of the plants under their care, the prevention of disease and injury, and the selection and improvement of varieties and races. Yet the knowledge of the simplest physiological processes and most elementary details of structure of the living objects they daily care for is astonishingly vague and unreliable. This lack of apprehension of the plant nature extends from the boy who washes flower pots to the proprietor of the establishment, with only here and there an exception, and yet no class of cultivators are quicker to comprehend and apply knowledge in their own line. A book giving the physiological meaning of practical operations, if clearly and pleasingly written, must therefore supply a real demand. Such a work, it seems to us, is Dr. Sorauer's Physiology of Plants in its English form.[1]

The field which the author essays to cover is largely unbroken, and so we are inclined to deal leniently with the shortcomings of the work, and more especially as it contains a great amount of most useful information in a form that is likely to prove attractive to the class of persons for whom intended. It can not be overlooked, however, that the title is misleading, as the work is in no proper sense a physiology of plants. It might be termed applied or economic botany based in part upon physiology, and in part upon ecology, whereas most works on applied botany are based upon structural and systematic botany.

The point of view is constantly that of the cultivator, and as such the treatment of the subject is logical and satisfactory. This accounts for the fact that many topics of great physiological interest, like certain portions of metabolism and nearly all of irritability, are not mentioned.

The work opens with an explanation of the true conception of a living plant organism, then passes in succession to consider the functions of root, stem, leaf, flower, and fruit, including, so far as required to understand their activities, some account of the elementary structure. Constant references to practical operations and advice upon the right performance of the same, with the physiological or ecological reasons therefor, give the work a genuine practical value, and rob it of the formality of pure science. Ample attention is given to strictly horticultural matters, *e. g.*, over twenty pages are devoted to pruning and thirty to propagating by cuttings and grafting.

Some fundamental topics are quite inadequately or even misleadingly treated, as the production of organic matter in green leaves, and

[1] SORAUER, PAUL: A popular treatise on the physiology of plants for the use of gardeners, or for students of horticulture and of agriculture. Trans. by F. E. Weiss. 8vo. pp. 256, figs. 33. London: Longmans, Green & Co., 1895.

the use of stomata. Much stress is laid upon the need of aerating the roots, but the author fails to explain why it is necessary if gases, as he says, can not pass through imperforate surfaces of plants.

Such defects, however, may be overlooked in view of the fact that the work is to teach a rational horticulture, and not to teach vegetable physiology. This is certainly the spirit of the book, in spite of the unfortunate title; and as such the work is admirable, and to be highly commended.

Minor Notices.

THE NATURALIST'S DIRECTORY[1] for 1895 comes to us with decided improvements. In addition to the alphabetical list, the names are arranged geographically (by states) and also by subjects. In the latter part of the work the editor has been obliged to omit names from some departments when ten or a dozen "specialties" had been given. But we judge that the real specialists will be found correctly listed. These two additional lists will greatly increase the usefulness of the book and we hope will bring a proper reward to the enterprising publisher and compiler.

THE ATTENTION of those who are following Mr. Charles Robertson's papers on "Flowers and insects" in this journal is directed to a paper by him in the Trans. St. Louis Academy of Science 6: 435–480. 1894, covering plants included in the families Rosaceæ and Compositæ.

TO BOTANISTS who have occasion to use statistical methods we cordially commend a pamphlet entitled "Statistical Methods," by G. W. Moorehouse. It is a reprint from *Mind and Body* and is published by the Freidenker Publishing Co., Milwaukee, Wis., at 25 cents.

THE BULLETIN of the Botanical Society of Geneva[1] covering the years 1892–4, contains eight papers, dealing chiefly with the local flora. Briquet's "Le Mont Vuache: étude floristique" and Paiche's "Observations sur quelques espèces critiques du genre Hieracium" are of most general interest.

THE LAST semi-annual report of Schimmel & Co. (Fritzsche Bros.) of Leipzig and New York contains notes on many essential oils, of equal interest to botanists and chemists.

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[1] CASSINO, S. E.—The naturalist's directory, containing the names, addresses, special departments of study, etc., of professional and amateur naturalists, chemists, physicists, astronomers, etc., of the U. S. and Canada. 12mo. pp. viii + 382. Boston: S. E. Cassino. 1895.

[1] Bulletin des travaux de la société botanique de Genève (section de la société suisse de botanique(no. 7, années 1892–1894. 8vo. pp. 241. 1 map. 2 figs. Genève: H. Georg. 1894.

OPEN LETTERS.

Astragalus lanocarpus and A. bajaensis.

It seems necessary to notice an ill-advised personal attack which Professor E. L. Greene has made upon me in a recent number of *Erythea*. Professor Greene's failure to keep pace with modern Latin scholarship, pardonable indeed in his case, has betrayed him into an uncalled for display of language.

The trouble seems to be that Mr. Greene objects to such a specific name as *lanocarpus* in the combination *Astragalus lanocarpus* lately published by me. I understand him to profess that the name is compounded of words taken from two languages. And because Mr. Greene has not been properly instructed that *carpus* is a good Latin word, he makes his personal attack upon me. In some moment of mental illumination I hope he will be sorry for this. He intimates that I "lack a grammar school education." He writes that I "have assumed that a mere beginner in systematic botany may unblushingly announce himself an authority upon so large and difficult a genus as Astragalus." That I am a mere beginner is true, although I have made systematic botany my principal occupation for about ten years. That I have announced myself as an authority is wholly untrue. I challenge Mr. Greene to produce a published word of mine in which I have made any such announcement. I consider myself but a student of the genus, and I assure Mr. Greene that upon his failure to produce proof of his unfounded statement, I shall expect a full and abject retraction.

So much for Professor Greene's lapse from courtesy. Regarding "carpus," I beg to refer Professor Greene to page 95 of vol. II of Furlanetto's splendid six volume work, "*Totius Latinatis Lexicon, opera et studia Algeidii Forcellini*," where he will find "*carpus*, genitive *carpi*, m. from Greek *karpos*." He will also learn that this word occurs in Roman inscriptions of the Empire period. He will discover that while earlier and insufficient study had excluded the word from the Latin vocabulary, later research has shown its place to be as unquestionable as *brevis*, for example, which is also from a Greek root. Yet Mr. Greene does not object to *brevifolia* or *breviflora*. Furthermore, he will learn that the Romans themselves used the compound word *omnicarpus*.

Briefly, then, *carpus* is a good Latin word, *cuspidocarpus*, *lanocarpus* and the rest are correctly formed, and in trying to change them, Mr. Greene has given birth to abortive synonyms.

The other mistake of Mr. Greene concerns the specific name *bajaensis*. *Baja*, he objects is a Spanish adjective, meaning *lower*. This is true, but it is also a substantive. *Baja*, for example, is the name of a town in the state of Coahuila, Mexico. Therefore, *bajaensis* is correct, just as *nevadensis* is correct.

I hope that this will show Mr. Greene the insecurity of dogmatism. —EDMUND P. SHELDON, *University of Minnesota*.

NOTES AND NEWS.

Mr. W. J. V. Osterhout is to spend the next college year in study in Germany.

Mr. E. W. D. Holway sailed for Europe on May 18th to be gone for sixty days.

The *Kew Bulletin* for March contains the descriptions of ten new species of ferns (seven of them Polypodiums) from western China, and a long list of African novelties.

The botanical collections made by Miss Mary E. Gilbreth were lately presented in her memory to Radcliffe College (Harvard Annex) by her mother, Mrs. Martha Bunker Gilbreth.

Mr. A. P. Anderson, assistant in the Department of Vegetable Physiology in the University of Minnesota, has gone abroad to study, intending to remain two years, most of the time in Munich.

The University of Colorado dedicated on March 9th the Hale scientific building, of which the third floor is devoted to biology. The arrangements in the laboratory and museum are said to be "admirable in every respect."

Mr. D. T. MacDougal, in charge of vegetable physiology in the University of Minnesota, sailed on the City of Rome, May 25th, for Glasgow, to spend three months abroad. He will be for most of the time in Professor Pfeffer's laboratory at Leipzig where he may be addressed.

The leaflets of *Menyanthes trifoliata* are given as "entire or repand." It has recently been found with distinctly three-lobed leaflets. Again, although it is a constant feature, I have never seen any mention of the marginal glands at the crenatures of the leaflets.—W. W. Bailey.

The fourth annual session of the summer school at the University of Minnesota will begin July 29th and close August 23d, 1895. Two courses in botany will be conducted by Edmund P. Sheldon, instructor in botany in the University of Minnesota, and John M. Holzinger, instructor in botany in the State Normal School, Winona.

At the meeting of the National Academy of Sciences in April, Professor Charles S. Sargent of Harvard University was elected to membership, and Professor Julius von Sachs of Würzburg, Germany, was made foreign associate. This is a good showing for botany, as only four members, and three foreign associates all told were elected at this session.

The first volume of the *Conspectus Floræ Africanæ* (vol. V, Monocotyledones) by Th. Durand has recently been published. Whereas a volume of 500 pages was promised, it really contains 977 pages; nevertheless no increase has been made in the price (20 fr.) The remainder of the work will appear by half volumes. Vol. 1, part 2, will be published before autumn.

DR. O. UHLWORM (Terrasse Nr. 7, Cassel, Germany) editorially connected with the *Botanisches Centralblatt* and the *Centralblatt für Bacteriologie und Parasitenkunde*, desires the co-operation of American botanists in increasing the value of the bibliographical departments of these journals. He would be pleased to receive from authors copies of their articles on all botanical subjects pure or applied.

THE STATE of New York has set aside $16,000 to be expended under the direction of Prof. L. H. Bailey of Cornell University, for conducting experiments in horticulture, discovering and remedying the diseases of plants, etc. This may reasonably be anticipated to yield much knowledge of value to the botanist as well as to the cultivator. The work is to be confined to the fruit-growing region of western New York, lying north and west of Cayuga Lake.

THE EIGHTH SEASON of the Marine Biological Laboratory at Wood's Hole, Mass., will be opened on June 1st. Instruction in botany will be in charge of W. A. Setchell, instructor in botany, Yale University, and W. J. V. Osterhout, instructor in botany, Brown University. Among special lecturers we note the following names of botanists: G. F. Atkinson, J. M. Coulter, J. M. Macfarlane, William Trelease, and W. P. Wilson.

DR. J. P. LOTSY associate in botany in the Johns Hopkins University, leaves at the end of the academic year to accept the position of assistant to Dr. Treub, the Director of the Botanic Gardens at Buitenzorg, Java. We hope this does not mean that the too slight recognition hitherto accorded to botany at Johns Hopkins is to be discontinued. It is very important that botanical instruction, and that of the best quality, be provided in an institution of such reputation as this. It is greatly to be desired, also, that the botanical side of the biological work be accorded its due prominence.

THE NEXT MEETING of the American Microscopical Society will be held at Cornell University, August 21–23, 1895, that is the week previous to the meeting of the American Association for the Advancement of Science at Springfield, Mass. Considering the geographical distribution of the members, Ithaca is as central a point as can be found for the meeting. The University buildings will be at the disposal of the Society. A good display of microscopical apparatus is promised. A special feature of the coming meeting will be the setting apart of one or more sessions for the reading of papers on methods and the demonstration of special or new methods. The chairman of the local committee is Prof. W. W. Rowlee.

SOME IMPORTANT notes on North American oaks have been published by Dr. C. S. Sargent in *Garden and Forest* (March 6th). A new white oak (*Q. Toumeyi*), from the mountains of southeastern Arizona, is described and figured; an examination of the type of *Q. grisea* Liebm. confirms Engelmann's opinion that it is a form of the polymorphous *Q. undulata;* a white oak of New Mexico and Arizona, heretofore mistaken for Liebmann's *Q. grisea*, is named *Q. Arizonica;* the great leaf variation of *Q. dumosa* is pointed out, including *Q. MacDonaldii* Greene, and Engelmann's var. *bullata* is changed to *revoluta*

on account of preoccupation; Buckley's *Q. Durandii* becomes *Q. brevilobata*, Torrey's original varietal name being taken up; *Q. Muehlenbergii* Engelm. becomes *Q. acuminata*, a varietal name given by Michaux; *Q. ilicifolia* is replaced by *Q. nana*, the original varietal name of Marshall; and Chapman's *Q. obtusifolia parvifolia* becomes *Q. Chapmani*, the name *parvifolia* being antedated.

SUMMER COURSES in biology are offered by the University of Pennsylvania, under the direction of Dr. W. P. Wilson, commencing July 1st and closing on the 26th. The botanical instruction will consist of three five-lecture courses by Professor Macfarlane, Professor Halsted and Professor Wilson; lectures on special topics by eminent botanists among whom are: Prof. L. H. Bailey (two lectures on "How Garden Varieties Originate: a Study in Evolution") and Prof. G. L. Goodale (an address before the students on "The Relations of Certain Plants to Political Economy"). Thirty hours of laboratory practice in biology will be given and five lectures by Mrs. Wilson on biology from the standpoint of teachers in the elementary schools.

LAST SUMMER those interested in the Marine Biological Laboratory at Woods Hole, Mass., instituted a movement to raise an adequate and permanent endowment in order to place the laboratory on an independent basis. This country has no marine station to compare with those of other countries and this lack is a serious obstacle to both zoological and botanical advancement in the United States. The botanical work of this station is advancing rapidly. A separate frame building was added last year and Dr. Setchell of Yale is drawing some very prominent workers to the study of marine botany from the large institutions. The attention of all biologists is called to the pressing needs of the institution, the first of which is the construction of a permanent building in order that the laboratory may be kept open the entire year. The erection of even a modest building will require more money than can be raised among workers at the station and the Boston friends, and biologists everywhere are asked to contribute. Money in any sums may be sent to Dr. C. O. Whitman, Woods Hole, Mass.

IN *Science* (March 22d) the paper of Dr. C. S. Minot, read at the recent meeting of the American Society of Morphologists, on "the fundamental difference between plants and animals," is published in full. The formal definitions are as follows: "Animals are organisms which take part of their food in the form of concrete particles, which are lodged in the cell protoplasm by the activity of the protoplasm itself; plants are organisms which obtain all their food in either the liquid or gaseous form by osmosis (diffusion)." The interesting speculation is offered "that the absorption of solid particles of food is to be considered one of the most essential factors in determining the evolution of the animal kingdom." "The plant receives its food passively by absorption, and the evolution of the plant world has been dominated by the tendency to increase the external surfaces, to make leaves and roots. The animal, on the contrary, has to obtain at least the solid part of its food by its own active exertions, and to the effects, through natural selection, of the active struggle to secure food we may safely attribute a large part of the evolution of locomotor, nervous and sensory systems of animals." Of course the correctness of the definition depends upon the definition of "food" in the two cases.

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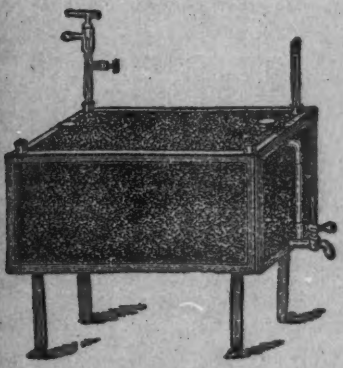

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